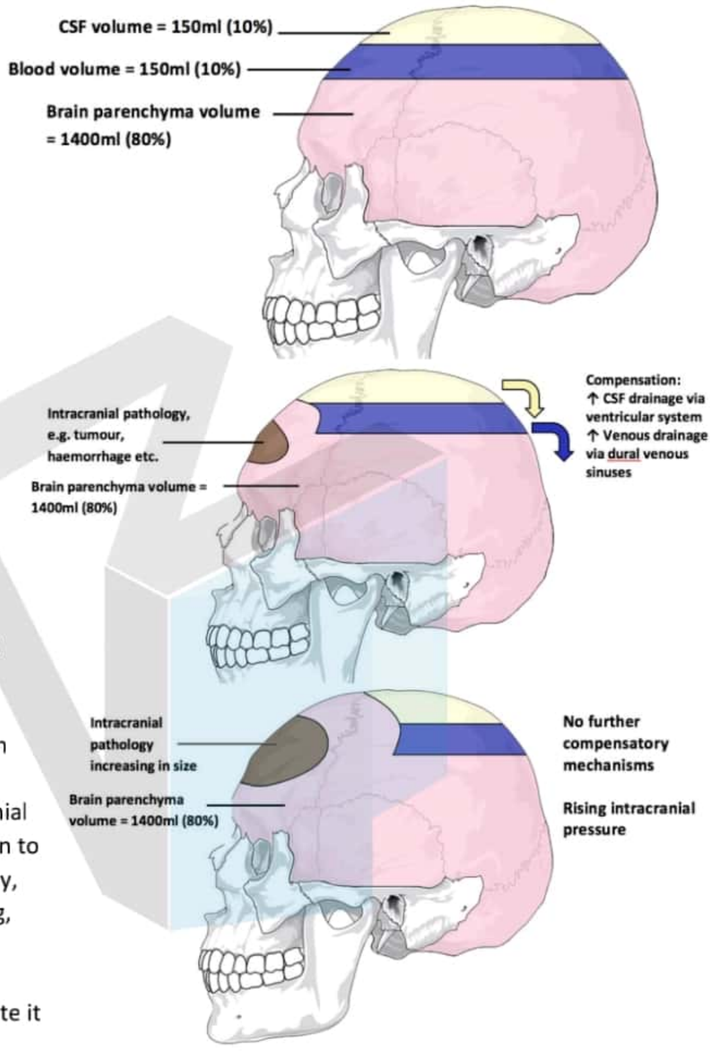
Neurosurgery

Munro- Kellie Doctrine

CPP= MAP – ICP

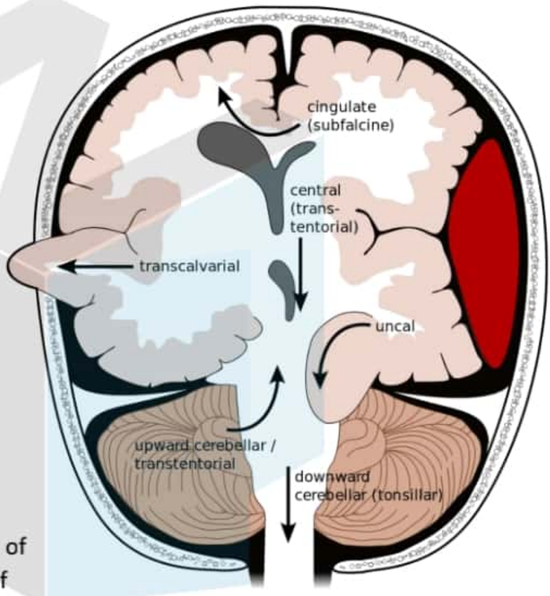
CCP: Cerebral Perfusion Pressure
MAP: Mean Arterial Pressure
ICP: Intracranial Pressure.


CSF volume = 150ml (10%)
Blood volume = 150ml (10%)
Brain parenchyma volume = 1400ml (80%)
Intracranial pathology, e.g. tumour, haemorrhage etc.
Brain parenchyma volume = 1400ml (80%)
Compensation:
↑ CSF drainage via ventricular system
↑ Venous drainage via dural venous sinuses
Intracranial pathology increasing in size
Brain parenchyma volume = 1400ml (80%)
No further compensatory mechanisms
Rising intracranial pressure

- If a pathological condition affects any one of the three components or a new component is introduced in to the fixed volume of the cranium, then this equilibrium may be disrupted.
- For example, if a patient develops a brain tumour, a new component (with its own volume and own contribution to intracranial pressure) is introduced in to the cranial cavity. Initially, as the tumour is growing, its volume may be small enough that the skull volume can accommodate it and compensatory mechanisms can be employed to maintain a normal intracranial pressure.
- The main compensatory mechanisms are increased drainage of blood or cerebrospinal fluid from the cranial cavity, in turn allowing for space to be created for this new lesion. This means that the intra-cranial pressure remains normal
- However, if the tumour continues to grow, it will reach a certain size where these compensatory mechanisms will become exhausted, whereby no further drainage of blood or CSF will be possible.
- At this point, the equilibrium becomes disrupted and the patient enters a decompensated state where intracranial pressure will begin to rise.

Brain Herniation

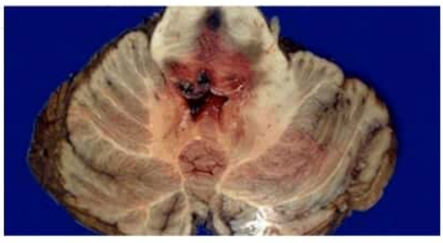
1. Subfalcine herniation
2. Midline shift of septum pellucidum (>5mm is significant and is the indication for craniotomy)
3. Temporal Herniation (Uncal herniation)
4. Central Herniation (Diencephalon compression)
5. Tonsillar herniation (Cerebellar tonsils)



Duret Hemorrhage

Duret haemorrhages are small linear areas of bleeding in the midbrain and upper pons of the brainstem. They are caused by a traumatic downward displacement of the brainstem.

Duret haemorrhages are haemorrhages from **intrapontine branch of basilar artery** secondary to raised intracranial pressure with formation of a transtentorial pressure cone involving the front part of the cerebral peduncles, the cerebral crura. Increased pressure above the tentorium may also involve other midbrain structures.



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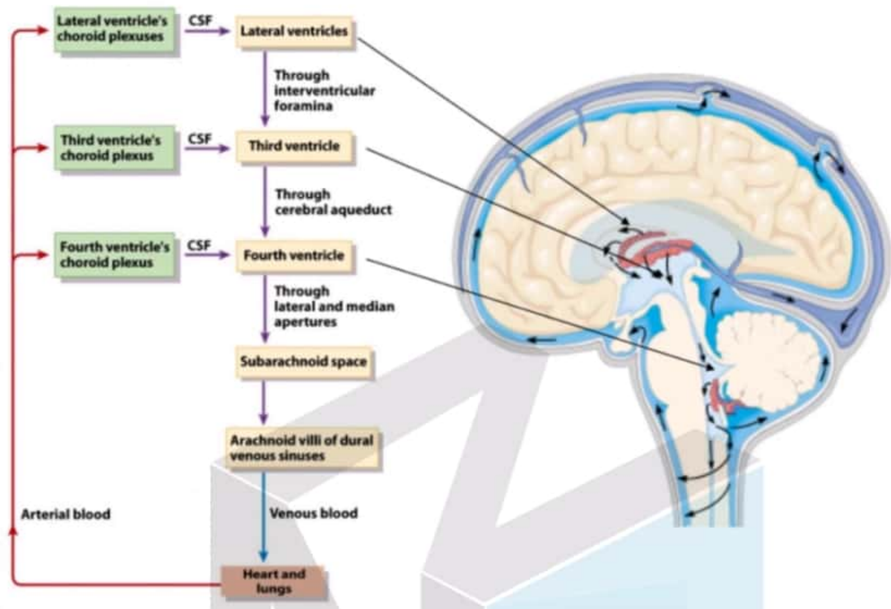
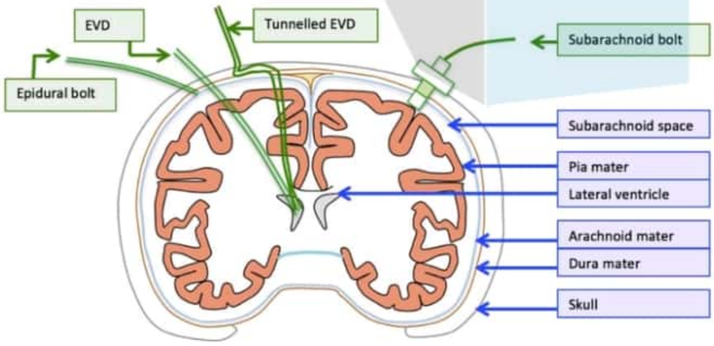
CSF Pathway



Management of Raised ICP

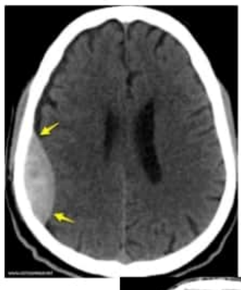
- **1st Line:** Conservative, Head elevation to 30-45 degrees, isothermia, isocapnea
- **2nd Line:** Osmotic Diuresis with Mannitol or Hypertonic Saline
- **3rd Line:** Heavy Dose sedation with Barbiturates.
- **4th Line:** EVD (External Ventricular Drainage) or Ventriculostomy

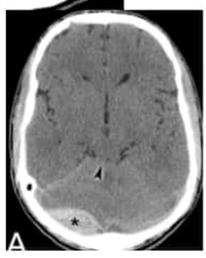


There two basic ICP monitor types are via **ICP data only** (commonly known as 'bolts') or **ICP data plus CSF drainage**. The three main types of ICP monitor are the External Ventricular Drain (EVD), the Subarachnoid Bolt, and the Epidural bolt.

These probes can often also be used to measure other physiological parameters, including temperature, lactate, and pH.

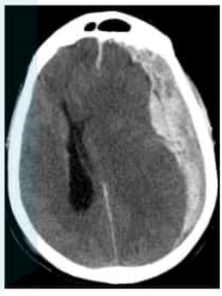
EPIDURAL HEMATOMA





- Location: Between dura and the skull
- Source: Ruptured Middle Meningeal Artery
- There is no parenchymal injury
- Associated with LUCID interval
- Mx: **Craniotomy** (1st line) and evacuation of hematoma [EXCELLENT prognosis]
- Radiology: Biconvex shape hematoma (because it is limited by the skull sutures)
- Burr Holes are not commonly done now
- Indications of Conservative Management (ALL must be satisfied)
  - <30 cc clot volume (<10 cc in Posterior Fossa EDH)
  - Clot thickness < 1.5cm
  - GCS 8 or more (hence not comatose, should be able to support spontaneous ventilation)

SUB-DURAL HEMATOMA



- Location: Between dura and the arachnoid
- Source: Ruptured bridging cortical vessels
- Associated with parenchymal injury
- Rarely associated with LUCID interval
- Radiology- Concavo-convex shape (because it is not limited by skull sutures)
- Limited by Falx cerebri
- Seen in Elderly, infants, and alcoholics.
- Elderly are prone because these vessels are already stretched due to reduction in size of brain due to atrophy.
- Management: Conservative (d/t cannot undertake surgery)

CHRONIC SDH

- The lesion becomes hypodense on CT because the hematoma liquifies.
- >2 weeks old SDH
- **Acute on Chronic** SDH: Presents with mixture of **hypodense and hyperdense areas on CT.** May be associated with a vascularised pseudomembranous surrounding the hematoma, which often gets traumatised to give fresh bleeding and hence cause acute symptoms.
- **SUBACUTE SDH- becomes isodense with brain** (virtually invisible on a CT SCAN)

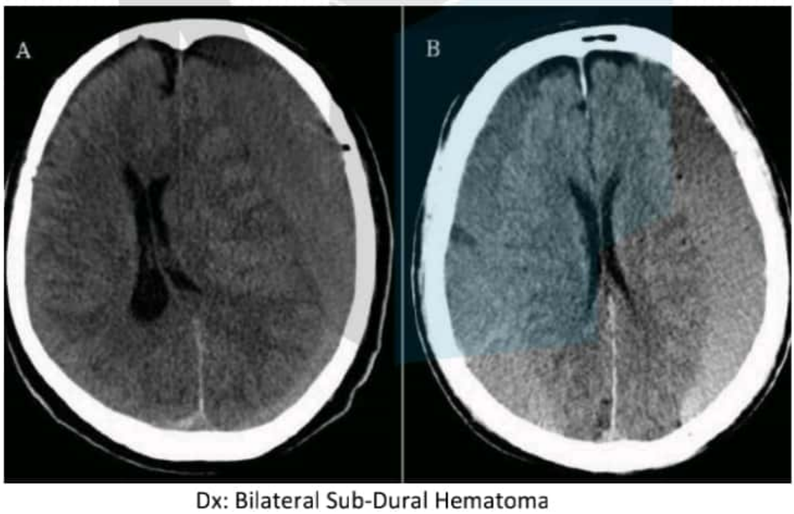
Management

- Acute and Chronic SDH- 1st line is always a conservative management
- Indications of **Surgery (Craniotomy acute SDH, Large Burr Hole for Chronic SDH)**:
  - **Acute SDH**
    - Clot thickness >1cm
    - Midline Shift of >5mm
    - Fall in GCS >2 base points
  - **Chronic SDH**
    - Clot thickness >1cm
    - All Acute on Chronic SDH

➔ Machine Oil Hematoma: Black appearance of products of hematoma drained in case of a chronic SDH

➔ **Concept of a Burr Hole**

- There is very limited role of Burr hole nowadays as NCCT Head is the diagnostic tool.
- Historically, Burr hole was used to determine the site of hematoma and type of hematoma
- The conventional burr hole is too small to drain a congested hematoma.



Dx: Bilateral Sub-Dural Hematoma